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# Report to NCSP on FY21 DANCE and NEUANCE measurements of $^{233}\text{U}(n, \gamma)$

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P-3  
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## 1 $^{233}\text{U}$ samples

The 30 mg of  $^{233}\text{U}$  material were supplied from Oak Ridge National Laboratory, as a solid oxide, which isotopic composition is given in the table 1,

Isotope	Atom (%)
$^{233}\text{U}$	99.9843
$^{234}\text{U}$	<0.0002
$^{235}\text{U}$	0.0017
$^{236}\text{U}$	0.0004
$^{238}\text{U}$	0.0134

Table 1:  $^{233}\text{U}$  isotopic composition. There was a  $^{232}\text{U}$  content of the  $^{233}\text{U}$  material that was calculated to be less than 1 ppm.

The initial plan was to make one thick 10 mg  $\text{U}_3$  sample, however we could get enough material to produce two  $^{233}\text{U}$  samples, of 20 mg and 10 mg, see figure 1. The two  $^{233}\text{U}$  samples were produced at LANL<sup>1</sup> by stippling the  $^{233}\text{U}$  in 0.3 mil Kapton foils, which has proved a robust, cost-effective method for producing actinide samples in the range of 1-20 mg in a small (<1 cm) diameter with very high efficiency.

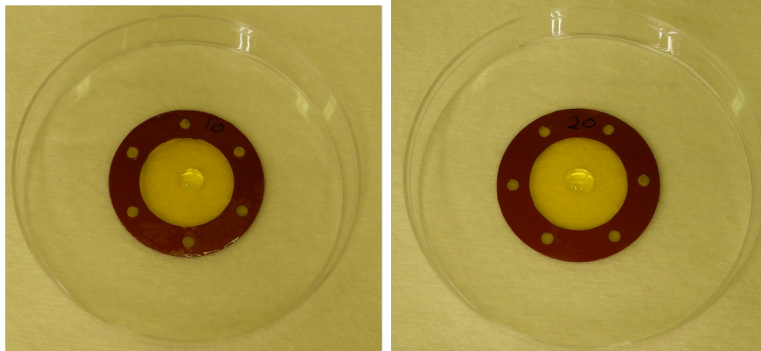


Figure 1:  $^{233}\text{U}$  10 mg sample (figure on the left), and 20 mg sample (figure on the right).

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<sup>1</sup>Prepared by Evelyn M. Bond at LANL.

## 2 Test of new $^{233}\text{U}$ sample for DANCE Measurement

The test measurement was performed over 10 days with the 20 mg sample, and then the 10 mg sample was placed in the beam for 1 day. The rest of the beam time was used to measure radioactive  $\gamma$  sources for energy calibration, background measurements and tests to define the  $^{233}\text{U}$  windows required during the data taking, also some measurements were done with a  $^{235}\text{U}$  sample to cross-check the performance and the systematics. Based on the analysis of the test measurement data, we have determined that this pair of new, thick targets will be appropriate for completion of the cross section measurement with DANCE.

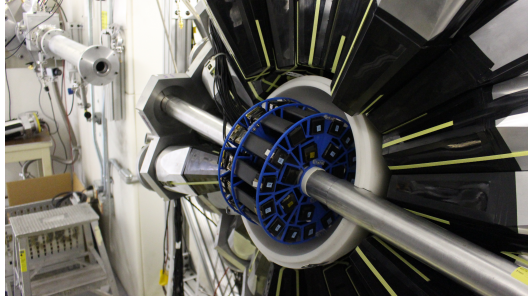


Figure 2: The NEUANCE instrument placed inside DANCE.

In order to complete the statistics needed above 10 keV, a production measurement of the  $^{233}\text{U}$  capture cross section, using the thick target ( $\sim 20$  mg) has been proposed for the CY21 run cycle. Through collaboration with the DANCE experimental team, we have arranged for the NEUANCE array to stay in place in the CY21 run cycle until the  $^{233}\text{U}$  measurement is complete, further reducing systematic uncertainties in the measurement.

## 3 Conclusions and next steps

The experimental measurement is ready to be performed. The measured data will be then analyzed and used to increase the statistics together with the data measured in December 2020. Further steps on the analysis with the new experimental data will be presented in the next report.